Total Points: / 40 Name:

1. **(4 pts (2 pts each))** Write arithmetic right shift and logical right shift representation for the following binary:
   * 1. 1000 1111
     2. 0111 0000
2. **(12 pts (6 pts each))**Use the Booth algorithm to multiply
3. 23 (multiplicand) by -29 (multiplier),
4. -15 (multiplicand) by -19 (multiplier),

where each number is represented using 6 bits. Show all the steps in a tabular form.

Binary for Multiplier (M) = -29=

Twos Complement of M=

Binary for multiplicand (Q)= 23

Twos Complement of Q=

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Initial Values | A | Q(23 ) | Q-1 | M (-29) |
| A<-- A-M  Arth. Right Shift |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Binary for Multiplier (M) = -15

Twos Complement of M=

Binary for multiplicand (Q)= -19

Twos Complement of Q=

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A | Q(-19) | Q-1 | M (-15) | Initial Values |
|  |  |  |  | A<-- A-M  Arth. Right Shift |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

1. **[20 pts]** Implement the Booths multiplier using Logisim. Submit the screenshot and the .circ file. It should be able to multiply two 4-bits numbers (remember result could be 8-bits)

**Use components provided by the logisim. You are allowed to use all components except the multiplier module in logisim. You will need the following to build the circuit.**

[Splitter](http://www.cburch.com/logisim/docs/2.6.0/en/libs/base/splitter.html).

[Probe](http://www.cburch.com/logisim/docs/2.6.0/en/libs/base/probe.html)

[Register](http://www.cburch.com/logisim/docs/2.3.0/libs/mem/register.html)

[Multiplexer](http://www.cburch.com/logisim/docs/2.3.0/libs/plexers/mux.html)

[Bitselector](http://www.cburch.com/logisim/docs/2.3.0/libs/plexers/selector.html)

[Comparator](http://www.cburch.com/logisim/docs/2.3.0/libs/arith/comparator.html)

[Shifter](http://www.cburch.com/logisim/docs/2.3.0/libs/arith/shifter.html)

[Counter](http://www.cburch.com/logisim/docs/2.3.0/libs/mem/counter.html)

[Buffer](http://www.cburch.com/logisim/docs/2.3.0/libs/gates/buffer.html)

[Bitextender](http://www.cburch.com/logisim/docs/2.6.0/en/libs/base/extender.html)

[Clock](http://www.cburch.com/logisim/docs/2.6.0/en/libs/base/clock.html)

[Adder](http://www.cburch.com/logisim/docs/2.6.0/en/libs/arith/adder.html)

[Subtractor](http://www.cburch.com/logisim/docs/2.6.0/en/libs/arith/subtractor.html)

Any gates